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(54) **Feed system for a pellet mill**

(57) The invention pertains to a pellet mill 2 for forming pelleted material, the pellet mill 2 comprising: A die 4 having a cylindrical inner surface 6 with a plurality of apertures 8 formed therein and extending to the outside of the die 4, the volume bounded by said inner cylindrical surface 6 defining a die chamber 10. At least two cylindrical rollers 12, 14, 16 adapted to travel over said inner cylindrical surface 6 of the die 4 in a rolling motion. Drive means for causing relative rotation of the die 4 and the rollers 12, 14, 16, so that the rollers 12, 14, 16 will travel over the inner cylindrical surface 6 of the die 4, thereby forming substantially wedge-shaped spaces 18, 20, 22 between the rollers 12, 14, 16 and the inner cylindrical

surface 6 of the die 4. A feed system, comprising at least two conduits 24, 26, 28, one associated with each of the at least two rollers 12, 14, 16, extending into the die chamber 10, each of the conduits 24, 26, 28 having a side opening 32 for feeding the pelletizable material 30 into the substantially wedge-shaped spaces 18, 20, 22 between the rollers 12, 14, 16 and the inner cylindrical surface 6 of the die 4, the side opening 32 extending axially along the conduit 24, 26, 28 and having an extension that is approximately equal to the length of the rollers 12, 14, 16, wherein at least one of the conduits 24, 26, 28 is configured for feeding the pelletizable material 30 directly to a substantially wedge-shaped space 22, which is at a higher location in the die chamber than said conduit 28.

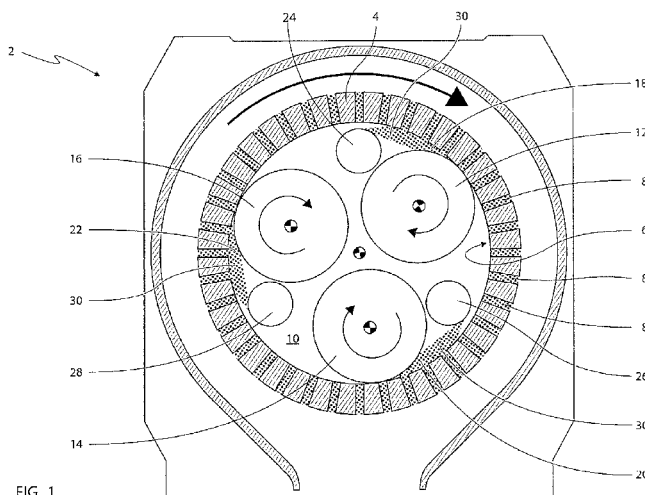


FIG. 1

Description

TECHNICAL FIELD

[0001] The present invention pertains to a pellet mill for forming pelleted material, the pellet mill comprising. A die having a cylindrical inner surface with a plurality of apertures formed therein and extending to the outside of the die, the volume bounded by said inner cylindrical surface defining a die chamber. The pellet mill further comprises at least two cylindrical rollers adapted to travel over said inner cylindrical surface of the die in a rolling motion, and drive means for causing relative rotation of the die and the rollers, so that the rollers will travel over the inner cylindrical surface of the die, thereby forming substantially wedge-shaped spaces between the rollers and the inner cylindrical surface of the die. The pellet mill also comprises a feed system for feeding the pelletizable material into the die chamber..

BACKGROUND OF THE INVENTION

[0002] Pellet mills with rollers that cooperate with a cylindrical die having a plurality of circular apertures are conventionally used to produce pellets for animal food or wood pellets that are used in furnaces or wood burning stoves, which for example are used in domestic or district heating systems

[0003] A problem with the commonly used pellet mills is that the pelletizable material is fed directly into the die cylinder, and therefore due to the influence of gravity has a tendency to accumulate in the "bottom" of the die chamber. This causes large unbalances in the pellet mill, because not all rollers are fed the same quantity of material, which material furthermore may be unevenly distributed along the width of the roller. These unbalances lead to an increased wear of the structural elements of the pellet mill, especially its bearings. Ultimately, this will lead to increased maintenance work on the pellet mill, which is unproductive while being maintained, and greatly reduces the lifetime of it.

[0004] To overcome these difficulties, a number of solutions have been suggested. For example in US 4,162,881 is disclosed a pellet mill with two side-by-side rollers which are disposed in respective first and second hemispheres (divided along a vertical center line) of rotation of a vertical rotatable cylindrical pellet die having a plurality of apertures. Pelletizable material is fed in independent first and second conduits for each roller. The first conduit deposits the pelletizable material in the first hemisphere above the first roller, while the second conduit supplies the pelletizable material also in the first hemisphere of rotation below the first roller. Thus, such material is initially deposited on the die member from the conduit and is carried during rotation by centrifugal force to the second roller. A problem with this pellet mill is that not all the material fed by the second conduit is carried to the second roller. The material has therefore a ten-

dency to build up in the bottom of the die chamber, which again will lead to the unbalances discussed above. Another disadvantage of this pellet mill is that it does not permit the use of a traditional shear pin safety mechanism, because the conduits would prevent the free rotation of the rollers, if the shear pin is broken.

[0005] In US 3,932,091 is disclosed a pellet mill for making food pellets from a flour product. The mill comprises a number of feed tubes, one for each extrusion roller, which tubes each extend axially through the interior of the annular die between the rollers and near the inner surface of the annular die. The flour product is fed to these tubes by screw conveyors. Each feed tube has a side opening having the same axial length as the associated roller and having a circumferential width which gradually increases inwardly. It is alleged that this leads to an even distribution of the flour product over the length of the roller and the effective width of the annular die

[0006] Furthermore, the documents US 3,807,926, US 4,711,622, US 3,045,280 and GB 757,133 disclose various feeding mechanisms for pellet mills

SUMMARY OF THE INVENTION

[0007] It is thus an object of the present invention to provide a pellet mill with an improved feed system, whereby the unbalances inherent to the prior art devices discussed above are alleviated

[0008] According to the present invention, the above-mentioned and other objects are fulfilled by a pellet mill for forming pelleted material, the pellet mill comprising the following main parts:

a die having a cylindrical inner surface with a plurality of apertures formed therein and extending to the outside of the die, the volume bounded by said inner cylindrical surface defining a die chamber,

at least two cylindrical rollers adapted to travel over said inner cylindrical surface of the die in a rolling motion,

drive means for causing relative rotation of the die and the rollers, so that the rollers will travel over the inner cylindrical surface of the die, thereby forming substantially wedge-shaped spaces between the rollers and the inner cylindrical surface of the die,

a feed system, comprising at least two conduits, one associated with each of the at least two rollers, extending into the die chamber, each of the conduits having a side opening for feeding the pelletizable material into the substantially wedge-shaped spaces between the rollers and the inner cylindrical surface of the die, the side opening extending axially along the conduit and having an extension that is approximately equal to the length of the rollers, wherein at least one of the conduits is configured for feeding

the pelletizable material directly to a substantially wedge-shaped space, which is at a higher location in the die chamber than said conduit.

[0009] By providing a side opening in the conduit extending axially along it, and having an extension that is approximately equal to the length of the rollers, an even distribution of the pelletizable material over the outer cylindrical surface of the rollers is achieved. This causes a more efficient use of the pellet mill, because virtually the full lengths of the rollers are used in the process. Furthermore, an even distribution of the pelletizable material over the full lengths of the rollers gives an even distribution of the load on the individual roller. It is of importance for the balancing of the forces acting on the individual structural parts of the pellet mill that the at least two rollers are placed symmetrically within the die chamber. Thus, one of the wedge-shaped spaces will be placed at a higher location than the conduit feeding pelletizable material to it. Hence, by feeding the pelletizable material directly to a substantially wedge-shaped space, which is at a higher location in the die chamber than said conduit from which it is fed, it is achieved that the pelletizable material is fed directly to the place where it is needed, and the problems mentioned above with the pelletizable material having a tendency to accumulate in the bottom of the die chamber are therefore completely alleviated or at least greatly reduced. Accordingly, a pellet mill according to the invention does not suffer from the unbalances prone to the prior art pellet mills, which leads to a greatly reduced wear on its bearings. This tremendously increases the lifetime of the pellet mill, as well as reduces the need for cumbersome and laborious maintenance.

[0010] According to an embodiment, the pellet mill may comprise at least three rollers and at least three associated conduits. This will greatly increase the pelletizable material processed by the pellet mill, because of the at least one extra roller. However, if the rollers are too small they will have a tendency to slip on the inner cylindrical surface of the die which will lead to unbalances and eventually a total stop of the pellet mill. Hence, too many rollers in any given die is also not beneficial. Thus, in a preferred embodiment, the pellet mill comprises three rollers. Hereby an optimal ratio between the radius of the rollers and the radius of the inner cylindrical surface of the die is achievable, wherein the pellet output is optimized and at the same time securing a reliable running of the pelleting process

[0011] Preferably, the at least one of the conduits, which is configured for feeding the pelletizable material directly to a substantially wedge-shaped space, which is at a higher location in the die chamber than said conduit, is configured for expelling the pelletizable material through its side opening in an upward direction.

[0012] A large variety of material can be pelletized by a pellet mill according to the invention. For example, the pellets may be employed in the mixed feed industry, oil industry, flour milling or bran pelletizing, and for the man-

ufacture of cattle feeds. It is well suited for pelletizing of a pulverized finely ground alfalfa hay product formed by dehydration of a leafy legume. Such leguminous materials include a gradation of particle sizes and densities with a leafy vein-containing portion and a stem portion with a latent adhesive material activated by contact with water.

[0013] For many pelletizable materials, such as hay, it is advantageous to provide heated water in the form of steam or the like to the product prior to or simultaneously with pelletizing. This may be accomplished in a number of different techniques. One technique includes a hopper which drops material into a feeding screw assembly which directs the pelletizable material to a mixing screw assembly to which steam and/or other liquids are added. From there, the moistened pelletizable material is directed to the at least two conduits.

[0014] According to a preferred embodiment, the pelletizable material is wood, provided in small particle sizes, for example sawdust or sawdust-like wood particles or slightly larger wood particles. The pelletizable material has preferably a particle size of less than 5 mm, more preferably between 1.5 and 3 mm. Pelletizing of wood particles is significantly more difficult than pelletizing animal food products, which contain starch, because the starch will act as a binder binding the material together. For example it requires typically 50 - 70 kWh to pelletize one ton of wood, while it only requires between 7 and 20 kWh to pelletize one ton of food material

[0015] The pellet mill may further comprise means for angular adjustment of each of the conduits about its longitudinal axis, thereby adjusting the direction, in which the pelletizable material is expelled through the side opening. Hereby is achieved that the feed of pelletizable material into the die chamber may be accurately adjusted, for example in dependence of the other structural parts of the pellet mill

[0016] Preferably, the conduits have a circular cross section, and each comprises a screw conveyor having a shaft tapering in the direction of feed

[0017] In a preferred embodiment, the pellet mill may further comprise drive means for driving the screw conveyors, which extend into the conduits independently of each other. Hereby is achieved that the quantity of pelletizable material that is feed into the wedge-shaped spaces may be individually adjusted.

[0018] According to another preferred embodiment, the pellet mill may further comprise drive means for dynamically adjusting the speed of each of the screw conveyors independently of each other, and in dependence of the measurement of at least one working condition of the pellet mill. Hereby is achieved that the quantity of pelletizable material, which is fed to each individual roller or each individual wedge-shaped space, may be stopped or reduced, if any particular roller for one reason or the other is not able to pelletize the material feed to it and thereby greatly reduce the risk of breakdown of the mill. Also in the event that one of the rollers has too little pel-

letizable material to work on, then it may lead to unbalances in the pellet mill and the associated problems referred to above. Therefore, it is by this embodiment also achieved that the quantity of material fed to any of the rollers of any of the wedge-shaped spaces may be increased if needed.

[0019] According to an embodiment, the conduits are connectable to a common material supply.

[0020] According to another preferred embodiment, the screw conveyors in the conduits are driven by a fixed relatively high angular speed. Each of the conduits (and thereby each screw conveyor) is connected to individual hopper means, which in turn are fed by individual dosing conveyors that feed each of said individual hopper means. In a further embodiment, each of these dosing conveyors are operatively connected to control means for individually adjusting the feed of pelletizable material to each individual hopper means associated with each individual conduit in dependence of at least one working condition of the pellet mill.

[0021] Each of the rollers may according to a preferred embodiment be mounted on a roller shaft having an eccentric stud portion, whereby it is possible to adjust the distance between the die and rollers in the event of a malfunction of one of the rollers.. For example each of the roller shafts may be equipped with a shear pin safety mechanism, so that in the event of overload of one of the rollers, the pin will be broken, and the roller shaft will then rotate about its eccentric axis, thereby increasing the distance between the roller and the inner cylindrical surface of the die and thus preventing a breakdown of the pellet mill. It is contemplated that a safety mechanism of this kind is just as effective as the shear pin safety mechanisms of the pellet mills known in the art. However, the present safety mechanism does not suffer from the same problems as those known in the art, because the rollers are not free to rotate within the die, whereby it is precluded that they would interfere with the conduits in the event of an overload of one of the rollers

[0022] According to yet another embodiment of a pellet mill according to invention, each of the rollers are mounted on a roller shaft, and each of the roller shafts is operatively connected to positioning means for individually adjusting the distance between each roller and the cylindrical inner surface of the die dependent on the measurement of at least one working condition of the pellet mill.

[0023] During use the rollers are subjected to large radial forces. These forces are caused by the pressure that is built up between the rollers and the inner cylindrical surface of the die, when the pelletizable material is compressed between them These forces are generally proportional to the quantity of material that is fed to each individual roller. Thus, if not exactly the same quantity of pelletizable material is fed to each roller at the same time, then these forces will not balance each other. And the pellet mill will thus suffer from unbalances. The difference in these forces gives rise to a resulting force, which will impact the structural elements which the rollers and die

are suspended from, especially the bearings will be subjected to substantial wear

[0024] Another problem with a pellet mill of the kind discussed above is that it can only work if the rollers are rotating. Under normal operating conditions, the rollers will rotate together with the die due to the frictional forces between the inner cylindrical surface of the die, the pelletizable material and the rollers. If a too large quantity of pelletizable material is fed to a roller, or if the pelletizable material does not cause a sufficiently large friction, then the roller will have a tendency to slide instead of rotate and therefore not be able to press the material through the apertures in the die. If in such a situation, material is still fed into the die chamber, and in particular to the sliding roller, then the particular wedge-shaped space in question will be overfilled and get stuck Usually such a malfunctioning will imply that the pellet mill has to be opened and the die chamber emptied totally for pelletizable material, before it may be started again.

[0025] Thus, the at least one working condition of the pellet mill that is mentioned above with respect to the description of various embodiments mentioned above, is preferably the angular speed of rotation of a roller and/or the physical distance between a roller and the inner cylindrical surface of the die, but may also comprise or be other working conditions of the pellet mill

[0026] If the angular speed of rotation of a roller slows down, it is an indication that it starts sliding, which again is an indication of the fact that this particular roller is fed too much pelletizable material. This information may then be used to slow down the screw conveyor in the conduit that is feeding that particular roller and/or it can be used to adjust the position of the roller so that it is moved away from the inner cylindrical surface of the die.

[0027] Similarly, if a measurement of the physical distance between a roller and the inner cylindrical surface of the die shows that it is increasing, this may be an indication that this particular roller is fed too much pelletizable material. This information may then be used to decrease the speed of the screw conveyor in the conduit that is feeding that particular roller and/or it can be used to adjust the position of the roller so that it is moved even further away from the inner cylindrical surface of the die, in order to prevent a breakdown of the pellet mill.

[0028] In any of the embodiments discussed above, the positioning means may comprise hydraulic cylinder and piston means. By applying hydraulic cylinder and piston means, the maximal force on any individual roller can be determined by a vent This implies that the force will be substantially constant during the pelleting process until possibly the maximal force is reached. In comparison to this setup, a spring loaded roller will exhibit a growing force in reaction to an increasing load on a roller

[0029] According to a preferred embodiment, the distance between a roller and the inner cylindrical surface of the die is dynamically adjusted in dependence of a measurement of the oil pressure of the hydraulic system associated with the hydraulic cylinder and piston means

that is operatively connected to that particular roller.

[0030] For example by setting the oil pressure in the hydraulic system to say 10% over the level that is necessary for producing the particular pellets, it will be possible to limit the unbalances in the system to a well-defined low level. The overall effect of this is that the pellet mill will suffer from smaller load or strain than those mills that are known in the art.

[0031] The pellet mill, e.g. the system of rollers, measurement means, drive means and positioning means, may be at least in part self-regulating. Preferably, the hydraulic pressure on a particular cylinder and piston means, which is operatively connected to a particular roller, is set to a fixed value. If a roller then is subjected to a pressure force that exceeds this fixed value of hydraulic pressure, then that particular roller is moved away from the inner cylindrical surface of the die. Hereby a so-called mat of unprocessed pelletizable material is left on the inner cylindrical surface of the die. This mat will therefore be sent to the next roller, which will then press the pelletizable material through the apertures in the die, or also this second roller will be moved away from the inner cylindrical surface of the die and send the material (back to the first roller in the embodiment with only two rollers, or) to the next roller in the pellet mill. If all of the rollers are moved away from the inner cylindrical surface of the die, this may be an indication that the pellet mill is loaded beyond its capacity, i.e. it is fed too much pelletizable material, where after the supply of pelletizable material to the die chamber of the pellet mill may be reduced, until the oil pressure in the hydraulic system(s) again is below the previously set fixed value at which it is able to maintain the position of the roller in its correct operating position

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] A further understanding of the nature and advantages of the present invention may be realized by reference to the remaining portions of the specification and the drawings. In the following, preferred embodiments of the invention are explained in more detail with reference to the drawings, wherein

- Fig. 1 schematically illustrates an embodiment of a pellet mill according to the invention,
- Fig. 2 shows an individual conduit,
- Fig. 3 shows a feed system for a pellet mill having three rollers,
- Fig. 4 illustrates a cross section showing an eccentric roller shaft,
- Fig. 5 illustrates a different cross section of the same configuration as shown in Fig. 4, and
- Fig. 6 shows a preferred embodiment of a pellet mill

with an improved feed system.

DETAILED DESCRIPTION

[0033] The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown. The invention may, however, be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete and will fully convey the scope of the invention to those skilled in the art. Like reference numerals refer to like elements throughout. Like elements will, thus, not be described in detail with respect to the description of each figure.

[0034] In Fig. 1 an embodiment of a pellet mill 2 according to the invention is schematically illustrated. The illustrated pellet mill 2 comprises a die 4 having a cylindrical inner surface 6 with a plurality of apertures 8 formed therein and extending to the outside of the die 4, the volume bounded by said inner cylindrical surface 6 defines a die chamber 10.

[0035] In the illustrated embodiment, the pellet mill 2 comprises three rollers 12, 14 and 16. Hereby an optimal ratio between the radius of the rollers 12, 14, 16 and the radius of the inner cylindrical surface 6 of the die 4 is achievable, where the pellet output is optimized and at the same time securing a reliable running of the pelleting process.

[0036] The rollers 12, 14, 16 are cylindrical and adapted to travel over said inner cylindrical surface 6 of the die 4 in a rolling motion as illustrated by the arrows on the rollers 12, 14, 16. The die 4 also rotates in the same direction as the rollers 12, 14, 16, as illustrated by the arrow placed above said die 4.

[0037] Although not illustrated in the present schematic illustration of the pellet mill 2, it also comprises drive means for causing relative rotation of the die 4 and the rollers 12, 14, 16, so that the rollers 12, 14, 16 will travel over the inner cylindrical surface 6 of the die 4, thereby forming substantially wedge-shaped spaces 18, 20, 22 between the rollers 12, 14, 16 and the inner cylindrical surface 6 of the die 4.

[0038] The pellet mill 2 also comprises a feed system, comprising three conduits 24, 26, 28, one associated with each of the rollers 12, 14, 16, extending into the die chamber 10, each of the conduits 24, 26, 28 has a side opening for feeding the pelletizable material 30 into the substantially wedge-shaped spaces 18, 20, 22 between the rollers 12, 14, 16 and the inner cylindrical surface 6 of the die 4. The conduit 28, which is associated with the roller 16, is configured for feeding the pelletizable material 30 directly to a substantially wedge-shaped space 22, which is at a higher location in the die chamber 10 than said conduit 28.

[0039] In Fig. 2 a single conduit 24 is schematically illustrated. The conduit 24 is equipped with a side opening

32, which extends axially along the conduit 24. The extension of this side opening 32 is approximately equal to the length of the roller 12.

[0040] The conduit 24 has a circular cross section and comprises a screw conveyor 34 having a shaft tapering in the direction of feed. Operatively connected to the screw conveyor 34 is drive means 36 for driving the screw conveyor 34. These drive means 36 are preferably a controllable electrical motor.

[0041] In principle the other conduits 26, 28 are similar to this one and will therefore not be illustrated separately. Hereby is achieved that the quantity of pelletizable material 30 that is fed into the wedge-shaped spaces 18, 20, 22 may be individually adjusted by controlling the drive means associated with each of the screw conveyors

[0042] In Fig. 3 a side view of the feed system for the pellet mill 2 in Fig. 1 is illustrated. The feed system comprises three conduits 24, 26, 28, and each of the conduits 24, 26, 28 is connected to an associated hopper means 38, 40, 42 for supplying pelletizable material to the conduits 24, 26, 28. The hopper means 38, 40, 42 are connected to a common material supply.

[0043] As illustrated in Fig 4, each of the rollers 12 may according to a preferred embodiment be mounted on a roller shaft 44 having an eccentric stud portion 43, whereby it is possible to adjust the distance between the inner cylindrical surface 6 of the die 4 and rollers 12 in the event of a malfunction of one of the rollers 12. For example each of the roller shafts 44 may be equipped with a shear pin safety mechanism so that in the event of overload of one of the rollers 12, the pin will be broken and the roller shaft 44 will then rotate about its eccentric axis 48, thereby increasing the distance between the roller 12 and the inner cylindrical surface 6 of the die 4 and thus preventing a breakdown of the pellet mill 2. During normal operation, the roller 12 will rotate around its center axis 46. It is contemplated that a safety mechanism of this kind is just as effective as the shear pin safety mechanisms of the pellet mills known in the art. However, the present safety mechanism does not suffer from the same problems as those known in the art, because the rollers 12 are not free to rotate within the die 4, whereby it is precluded that they would interfere with the conduits 24, 26, 28 in the event of an overload of one of the rollers 12, 14, 16.

[0044] Fig. 5 merely illustrates a different cross section of the same configuration as shown in Fig. 4.

[0045] Fig. 6 shows a preferred embodiment of a pellet mill 2 with an improved feed system. The die 4 (not shown) is placed inside a die housing 50. The screw conveyors in the conduits (not shown) are each driven by an electrical motor 36 at a fixed relatively high angular speed. Each of the conduits (and thereby each screw conveyor) is connected to individual hopper means 38, 40, 42, which in turn are fed by individual dosing conveyors 52, 54, 56 that feed each of said individual hopper means 38, 40, 42. The dosing conveyors 52, 54, 56 are each driven by an individual electrical motor 58.

[0046] In a further embodiment, each of these electri-

cal motors 58 may be operatively connected to control means for individually adjusting the angular speed of the associated dosing conveyor 52, 54, 56 and thereby the feed of pelletizable material to each individual hopper means 38, 40, 42 associated with each individual conduit in dependence of at least one working condition of the pellet mill. This working condition is preferably the detection of an overload of the pellet mill 2 and may in particular be any of the working conditions mentioned above or in the section "summary of the invention". The dosing conveyors 52, 54, 56 are embodied as screw conveyors and they are preferably connected to a common material supply via individual hopper means.

15 LIST OF REFERENCE NUMBERS

[0047] In the following is given a list of reference numbers that are used in the detailed description of the invention

20	2	pellet mill
	4	die
25	6	inner cylindrical surface of the die
	8	apertures in the die
	10	die chamber
30	12, 14, 16	rollers
	18, 20, 22	substantially wedge-shaped spaces
35	24, 26, 28	conduits
	30	pelletizable material
	32	side opening in the conduit
40	34	screw conveyor
	36	drive means for driving the screw conveyor
45	38, 40, 42	hopper means for feeding the conduits with pelletizable material
	43	eccentric stud portion of roller shaft
50	44	roller shaft
	46	center axis of roller
	48	eccentric axis of roller
55	50	die housing
	52, 54, 56	dosing conveyors

58 drive means of the dosing conveyors

Claims

1. A pellet mill (2) for forming pelleted material, comprising:

a die (4) having a cylindrical inner surface (6) with a plurality of apertures (8) formed therein and extending to the outside of the die (4), the volume bounded by said inner cylindrical surface (6) defining a die chamber (10), at least two cylindrical rollers (12, 14, 16) adapted to travel over said inner cylindrical surface (6) of the die (4) in a rolling motion, drive means for causing relative rotation of the die (4) and the rollers (12, 14, 16), so that the rollers (12, 14, 16) will travel over the inner cylindrical surface (6) of the die (4), thereby forming substantially wedge-shaped spaces (18, 20, 22) between the rollers (12, 14, 16) and the inner cylindrical surface (6) of the die (4), a feed system, comprising at least two conduits (24, 26, 28), one associated with each of the at least two rollers (12, 14, 16), extending into the die chamber (10), each of the conduits (24, 26, 28) having a side opening (32) for feeding the pelletizable material (30) into the substantially wedge-shaped spaces (18, 20, 22) between the rollers (12, 14, 16) and the inner cylindrical surface (6) of the die (4), the side opening (32) extending axially along the conduit (24, 26, 28) and having an extension that is approximately equal to the length of the rollers (12, 14, 16), wherein at least one of the conduits (24, 26, 28) is configured for feeding the pelletizable material (30) directly to a substantially wedge-shaped space (22), which is at a higher location in the die chamber than said conduit (28)

2. A pellet mill (2) according to claim 1, comprising at least three rollers (12, 14, 16) and at least three associated conduits (24, 26, 28).
3. A pellet mill (2) according to claim 1 or 2, wherein the at least one of the conduits (28), which is configured for feeding the pelletizable material (30) directly to a substantially wedge-shaped space (22), which is at a higher location in the die chamber (10) than said conduit (28), is configured for expelling the pelletizable material (30) through its side opening (32) in an upward direction.
4. A pellet mill (2) according to claim 1, 2 or 3, further comprising means for angular adjustment of each of the conduits (24, 26, 28) about its longitudinal axis, thereby adjusting the direction, in which the pelletiz-

able material (30) is expelled through the side opening (32)

5. A pellet mill (2) according to any of the preceding claims, wherein the conduits (24, 26, 28) have a circular cross section, and each comprises a screw conveyor (34) having a shaft tapering in the direction of feed.
6. A pellet mill (2) according to claim 5, further comprising drive means (36) for driving the screw conveyors (34) independently of each other.
7. A pellet mill (2) according to claim 5, further comprising drive means (36) for dynamically adjusting the speed of each of the screw conveyors (34) independently of each other, and in dependence of the measurement of at least one working condition of the pellet mill (2).
8. A pellet mill (2) according to claim 5, further comprising individual hopper means (38, 40, 42) connected to each of the conduits (24, 26, 28), wherein each of the individual hopper means (38, 40, 42) are connected to a dosing conveyor (52, 54, 56) for feeding pelletizable material (30) to each individual conduit (24, 26, 28).
9. A pellet mill (2) according to claim 8, wherein each of these dosing conveyors (52, 54, 56) are operatively connected to control means for individually adjusting the feed of pelletizable material (30) to each individual hopper means (38, 40, 42) associated with each individual conduit (24, 26, 28) in dependence of at least one working condition of the pellet mill
10. A pellet mill (2) according to any of the preceding claims, wherein each of the rollers (12, 14, 16) are mounted on a roller shaft having an eccentric stud
11. A pellet mill (2) according to claim 10, wherein each of the roller shafts are operatively connected to positioning means for individually adjusting the distance between each roller (12, 14, 16) and the cylindrical inner surface (6) of the die (4) dependent on the measurement of at least one working condition of the pellet mill (2).
12. A pellet mill (2) according to any of the claims 1 - 10, wherein each of the rollers (12, 14, 16) are mounted on a roller shaft, and wherein each of the roller shafts is operatively connected to positioning means for individually adjusting the distance between each roller (12, 14, 16) and the cylindrical inner surface (6) of the die (4) dependent on the measurement of at least one working condition of the pellet mill (2)
13. A pellet mill (2) according to claim 9, 11 or 12, wherein

the at least one working condition of the pellet mill (2) is the angular speed of rotation of a roller (12, 14, 16) and/or the physical distance between a roller (12, 14, 16) and the inner cylindrical surface (6) of the die (4).

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- 14.** A pellet mill (2) according to claim 11, 12 or 13, wherein the positioning means comprises hydraulic cylinder and piston means.

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- 15.** A pellet mill (2) according to claim 14, wherein distance between a roller (12, 14, 16) and the inner cylindrical surface (6) of the die (4) is adjusted dependent on a measurement of the oil pressure of the hydraulic system associated with the hydraulic cylinder and piston means..

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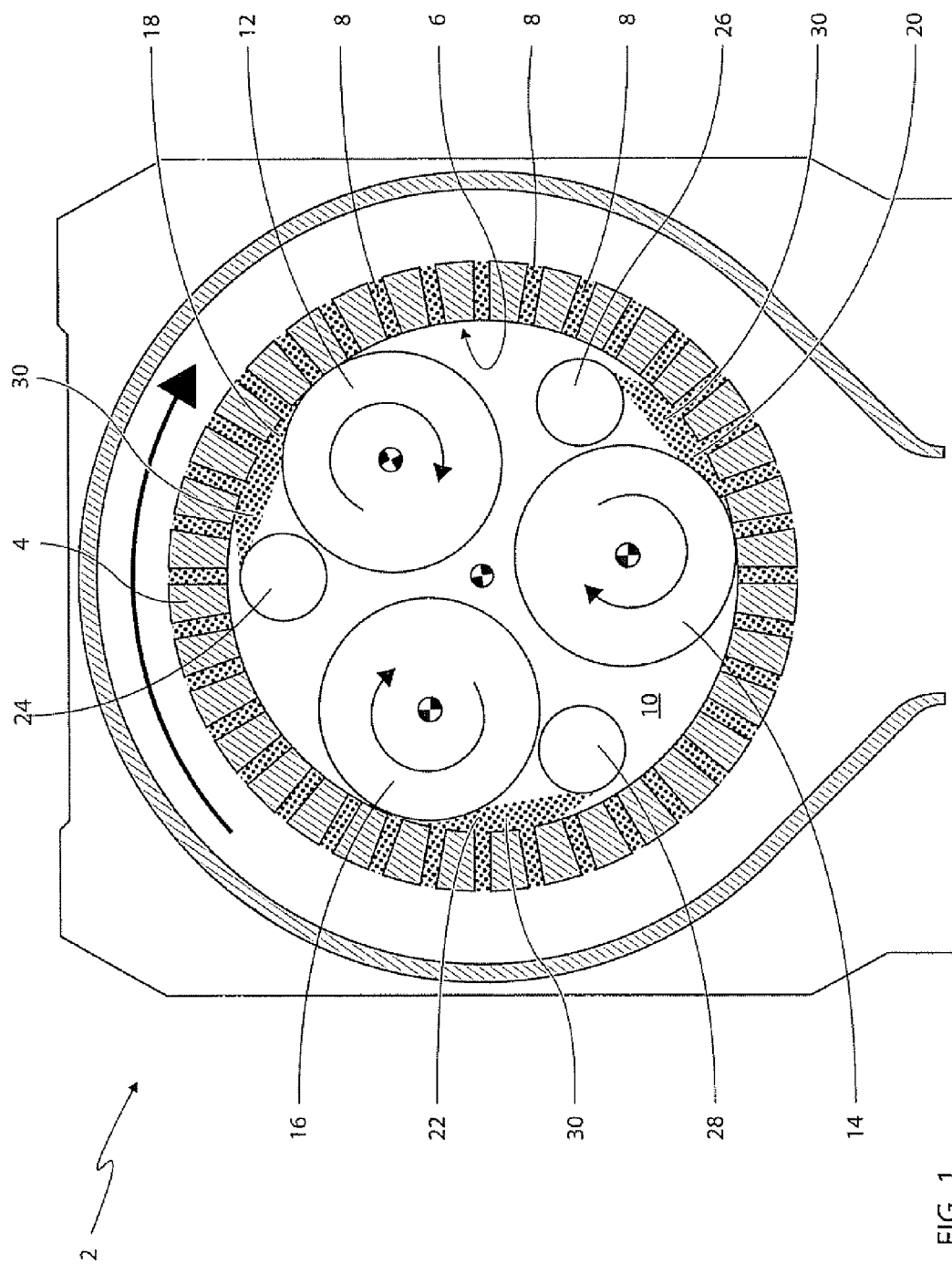


FIG. 1

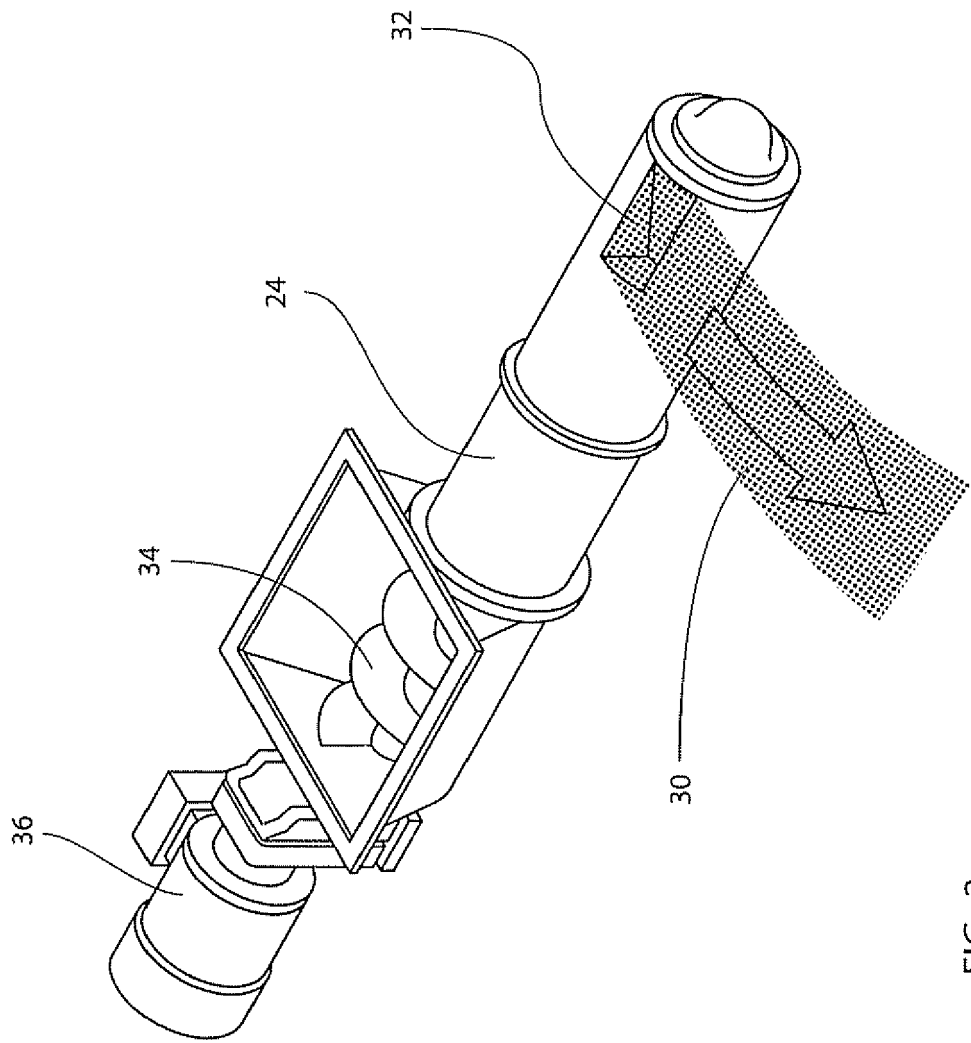


FIG. 2

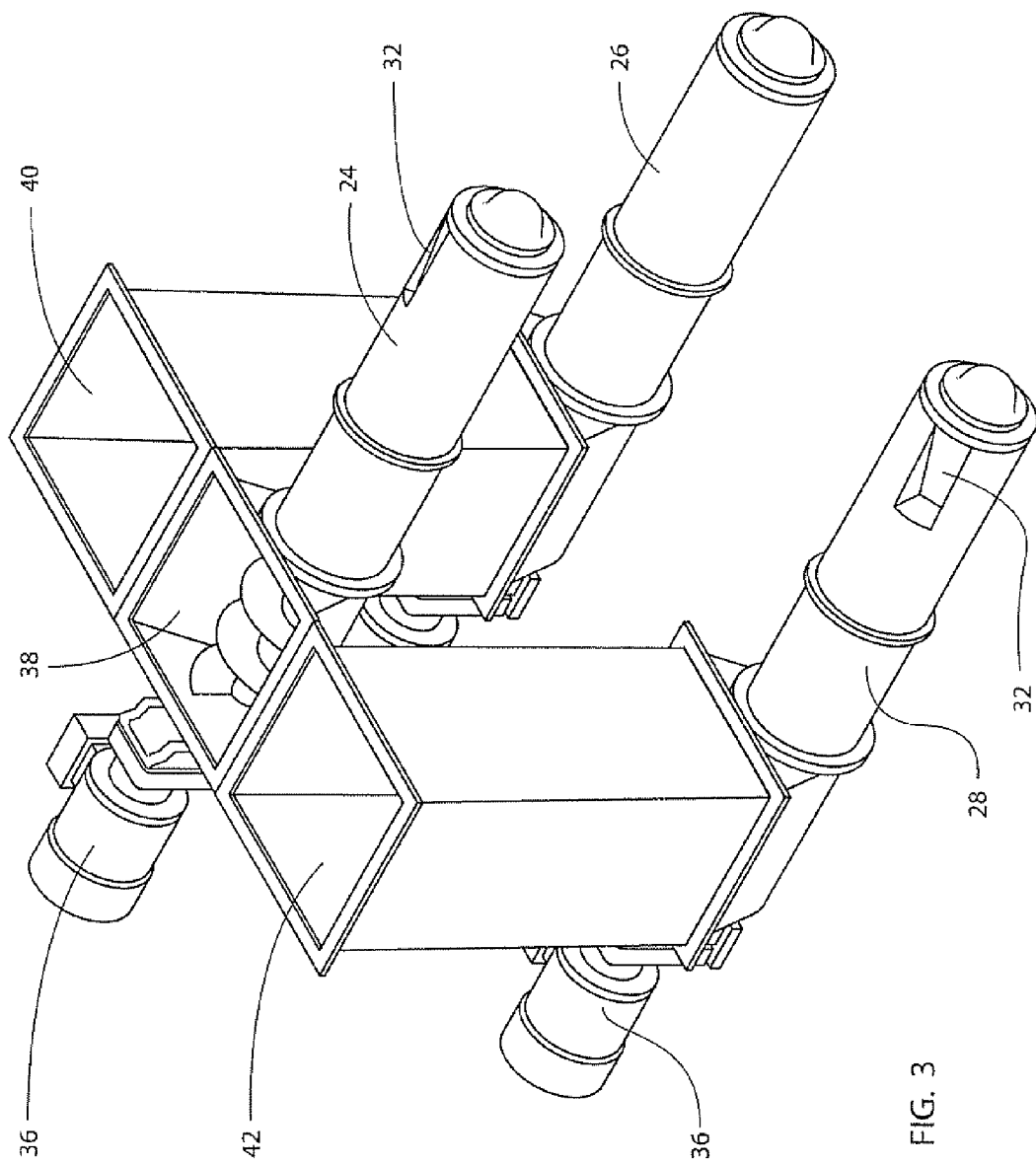


FIG. 3

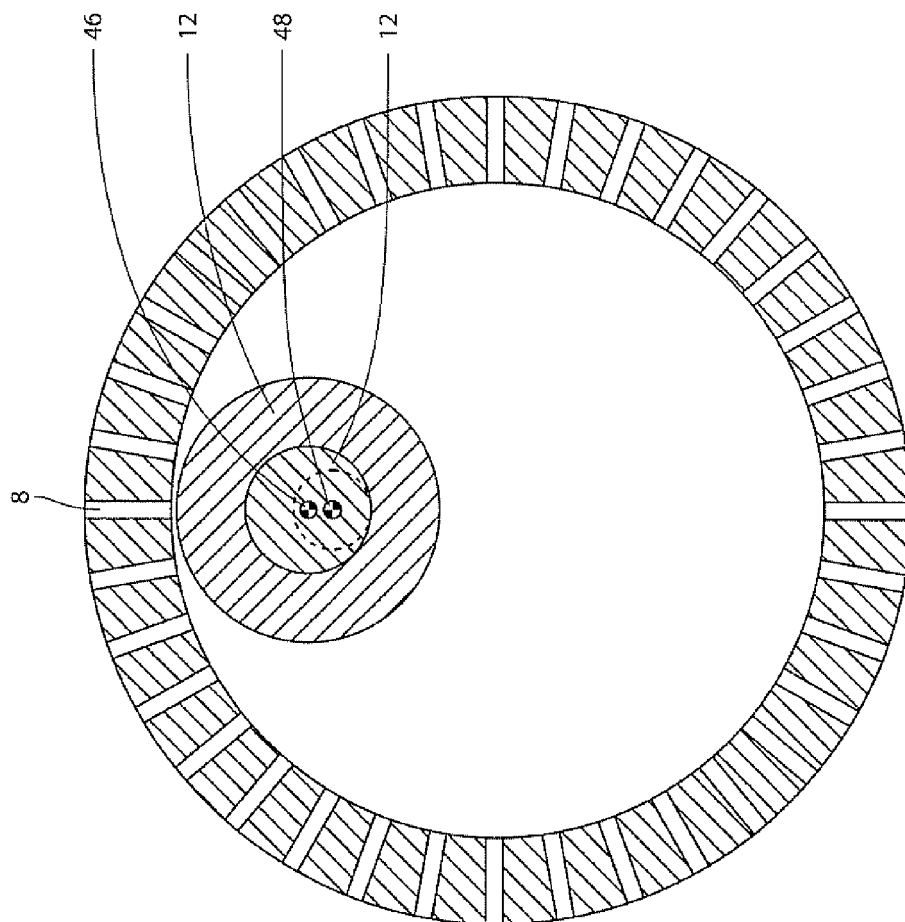


FIG. 5

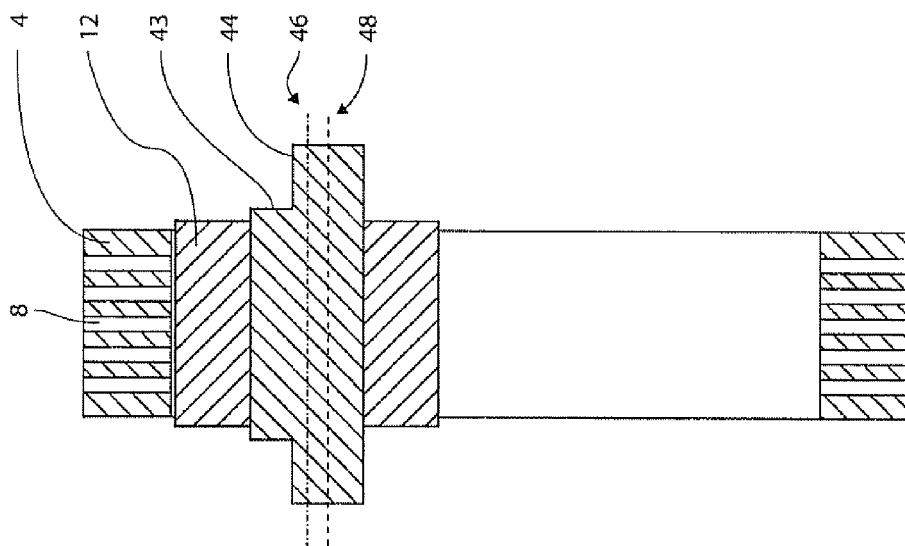


FIG. 4

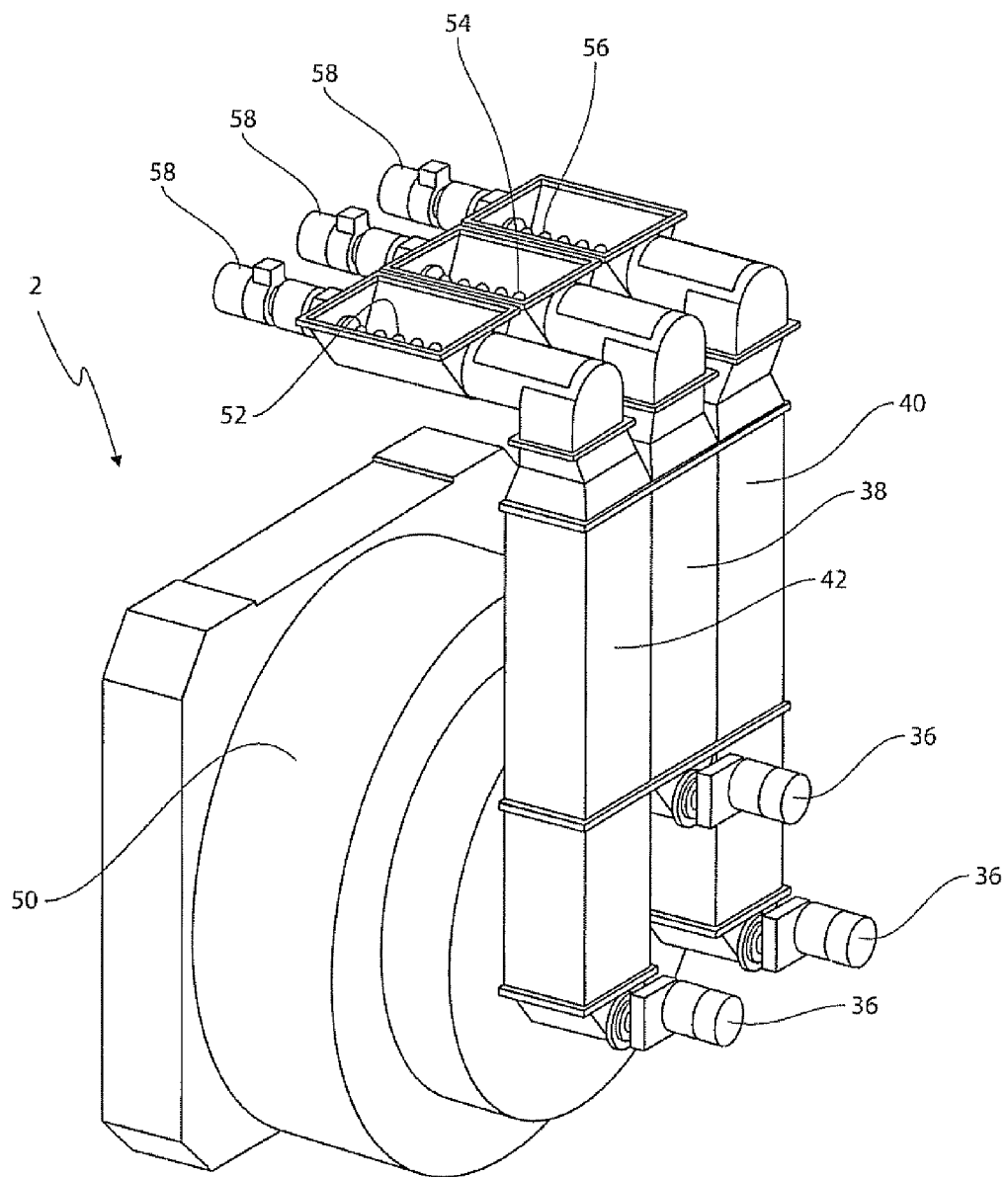


FIG. 6



EUROPEAN SEARCH REPORT

Application Number
EP 11 16 4251

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